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Reliability Society

N E W S L E T T E R

April 1997

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President's Report

1997 Reliability Society officers were installed at the January AdCom banquet in Philadelphia and the class of 1997 members were introduced. This new class of AdCom members brings fresh ideas and energy to the society. Several ideas were suggested at the AdCom and further work is being pursued. Just to mention a few: expanding the Society Webpage, documenting the Standards development process, and developing new conference sponsorships. Merrill Buckley, Division VI Director, joined our meeting and banquet.

Michael Pecht was awarded the 1996 Annual Reliability Society Award for his contributions to the IEEE Transactions on Reliability, his work in CALCE Electronic Packaging Center and his work on Reliability Standards. The annual chapter awards, usually presented at the January AdCom, will be presented at the April AdCom banquet in Denver. Congratulations to all 12 chapters who entered and especially to the 1st, 2nd and 3rd prize winning chapters: Boston, Switzerland, and Dallas who tied with Denver/Pikes Peak.

The Technical Activities Board (TAB) meeting was held in February in San Antonio. The establishment of two new Reliability Society awards were approved: The Reliability Society Education Award and the IEEE Reliability Society Best Paper Award - IEEE Transactions on Reliability. This year the Reliability Society joins the TAB Intelligent Transportation Systems (ITS) Committee and is a co-sponsor of the ITS conference in 1997 (ITSC'97) being held in Boston, MA on November 9-12, 1997.

There are several activities going on and we need more volunteers to help with the existing projects or to start new ones. I invite you to get involved by calling myself or any of the Society officers. The AdCom will meet next in Denver on April 9, then in the Washington DC area in July and in Albuquerque in October. Check your schedules to possibly join us at one of our meetings and meet the officers.

Loretta Arellano
Reliability Society President

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EDITORS COLUMN

Education in our technical field should not stop with ourselves. Others who use the information that we produce need to know what to do with it. The primary interface is with management. There will always be a potential communications gap between the technical and managerial ranks. Each has its own language and pressing needs to be attended. For technical evaluations to be useful they need to be recognized by management and understood to a comfort level that allows them to act. What it takes to get that "warm and fuzzy" feeling about an analysis or conclusion will obviously vary from person to person. It should be incumbent on both management and analyst to put an effort into understanding each other so that communication can occur. For the analyst, I seem to remember Juran referring to the need to talk money, the language of management. A complete analysis should include its economic effects or give results that can be

easily followed on with an economic impact. Management also needs to invest some effort into understanding the technical aspects of an analysis. Its not sufficient to just accept a "black box" analysis or outright reject it. We have probably all had our experiences with educating management about some technical facet of an analysis. These efforts always seems to be done on a reactive basis from one crisis to another. From our side of the equation, we need to get ahead of the curve and help improve the technical education of management. We should be setting aside a block of time each month to brief management on our specialty by showing them how we contribute to the bottom line. Only when both sides understand something about each other can effective communication commence.

Bruce Bream
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CHAPTER ACTIVITIES

Boston Chapter

We started 1997 with a combined monthly meeting/plant tour at M/A-COM, a subsidiary of AMP Co. M/A-COM manufactures a wide variety of RF electronic components and assemblies. Dana Crowe, Corporate Reliability Manager, and his staff provided a tour of their facilities, which includes a variety of equipment ranging from electron scanning microscope equipment to system level reliability testing equipment. After the plant tour, we had pizza followed by Dana's presentation entitled "A Key to Sustaining Competitive Advantage." The January meeting at M/A-COM was one of our best attended meetings in a long time, with almost half of the attendees being non-IEEE members.

In February, we returned to our usual meeting location at Hanscom Air Force Base. Otis Smith of Scott Quality Systems Registrars, spoke on "How some industries are putting teeth into the design control elements of ISO 9000 and the potential effects related to reliability activities." In March, John Peter Rooney of the Foxboro Co. gave a presentation entitled "A map is not a journey", in regard to reliability program planning. Both of these presentations were directly related to our monthly meeting theme of "Reliability and the QA Regulatory Standards."

Our main event of the year, the Annual Spring Reliability Symposium (35 years running), will be held on April 24, 1997 at the Holiday Inn in Boxborough, MA. This year's symposium theme is "Computer and Communication System Reliability", although some papers not directly addressing the theme will also be included. We will be trying out a slightly different format this year, with a combination of full papers and tutorials.

Please visit our home page at http://www.channel1.com/users/ieee/home.html - not only does it contain detailed information on our events, but it also contains a listing of recent job opportunities.

Finally, I am happy to announce that the Boston Chapter won first place in the 1995-1996 annual awards competition sponsored by the National Reliability Society!

Philip Tsung, Chair
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Dallas IEEE Reliability Society News

The Dallas chapter is completing its 1996-97 session as it began - with a diverse agenda of speakers and subjects in our ongoing attempt to attract a wide cross-section of active participants. In December, we joined the Association of Software Engineering Excellence (ASEE) in welcoming Dr. Carol Smidts, Assoc. Prof. in

Reliability Engineering. at the University of Maryland Materials & Nuclear Engineering. Dept. Dr. Smidts provided an interesting presentation of "Early Software Reliability Prediction", in which she forwarded a new framework and model for providing early reliability predictions, based on process and product attributes.

Dr. Vallabh Dhudshia, Senior Member of the Technical Staff, TI Semiconductor Group's Center for Supplier Excellence, presented "Early Supplier Involvement (ESI)-- A Paradigm Shift" at the January meeting. He outlined the ESI process and discussed the advantages of engaging with key suppliers early in development to create a cooperative framework for creating effective and reliable products.

Dr. Michael Pecht, Director of the CALCE Electronics Packaging Research Center Lab at the University of Maryland, provided his observations and insights regarding the growth of the Electronics Industry in Southeast Asia. He noted that many of the technologies are developed in the U.S., only to be abandoned and exported to Asian countries. He cited the existence of broad-based infrastructure support systems in those countries as one of the key differences in new product success rates.

Upcoming meeting speakers and presentations:

- Clyde Dunn, Product Development Reliability Manager, TI Semiconductor Group, will discuss "FLASH Memory Data Disturb Mechanisms". This presentation will cover the failure mechanisms associated with the two most widely published reliability concerns for FLASH memories -- write/erase endurance and data disturb.
- In April Michelle Richards, Business Excellence Manager of TI Corporate Services Facilities, will present "Improved Reliability and Efficiency Through Knowledge Based Management". This presentation will introduce Facilities' data acquisition and process methods used to manage resources and improve reliability in a 24 hrs/day, 7 days/wk operation.
- Marv Bellamy, Raytheon/TI, will recap the recent results of the "Environmental Stress Screening 2000" efforts at our May meeting. This project, sponsored by the National Center for Manufacturing Sciences, entailed three companies evaluating their products, using three accelerated ESS processes. This discussion will summarize the technologies/processes evaluated and the conclusions reached.

Joe Childs, P.E.
Chair, Dallas Chapter

Los Angeles Chapter

Dr. Samuel J. Keene will present a new reliability prediction model to our chapter in March. It combines hardware and software failure rates. The software component of the model predicts the latent fault rate of the code at shipment. This prediction is based upon the maturity of the underlying process the development team used to produce the code. The model then translates the design measure of faults/KLSOC (thousands of lines of source code) to an operational failure rate. This is the expected failure rate of the software over calendar time in the field. The hardware prediction process also takes into account for the quality of its underlying development process. The more initiatives taken in development equate to the better expected reliability of the resulting product. The chief failure drivers are due to special cause. As such they are amenable to being designed out of the system. This model recognizes and rewards the use of proactive measures to reduce the failure rate of the system.

Dr. Keene is an IEEE Fellow, a past president of the IEEE Reliability Society, and was recognized as the "Reliability Engineer of the Year" in 1995 by the Reliability Society. He is a

teacher, practitioner and researcher in the reliability field. He has authored over 100 papers and text chapters in the reliability field. He is an internationally invited speaker and is featured in six video productions. The most recent was on the topic of Concurrent Engineering. A field closely aligned to reliability.

Our activities are now posted on the LA Council Home page on the web at http://www.ieee-lac.org/ieee-lac/

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Philadelphia Chapter

Here's a summary of our January 21st meeting:

"Novel Magnetic Materials for Soft and Hard Magnetic Applications" - Dr. Kalathur Narasimhan
For some time magnetic materials have been a dormant field with very little advances in the lamination steels area. A novel magnetic material has been developed with low core losses at higher frequencies with induction exceeding 12,000 gauss at about 40 Oe field. These materials are finding use in brushless d.c. motors and electronic ignition coil systems. Opportunities with this new material was discussed. As review of the status of neodymium iron-boron magnets, research, production, and applications was also discussed. These magnets revolutionized the disc drive industry and offer opportunities in d.c. motors.

"Solid Modeling and Rapid Prototyping in Concurrent Engineering" - Mr. Joseph Ranieri and Mr. Ray Biery
This presentation first described the concurrent engineering environment and described the key role that solid modeling plays. This included a brief overview on the key supported technologies including Computer-Aided Manufacturing, Design for Manufacture and Assembly, and Finite Element Analysis. The presentation then defined Rapid Prototyping and discussed the role that it plays in concurrent engineering. Following this, the leading rapid prototyping technologies was described and compared.

Fulvio E. Oliveto, Chairperson
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Swiss Chapter

Since its founding on January 28, 1991, the Executive Committee of the Switzerland Reliability Chapter was composed by A. Birolini (Chairman), F. Bonzanigo, P.L. Boyer (Treasurer), R. Brinkman, M. Ciappa (Secretary), R. Leemann, and G.A. Zardini (Vice Chairman). After two terms it was time to renew the Chapter's ExComm. Starting from February 1, 1997, the Officers of the new committee are:

M. Ciappa, ETH, Zurich (Chairman)
G.A. Zardini, Consulenze industriali, Chiasso (Vice-Chairman)
Dr. R. Zehringer, ABB Management, Daettwil (Secretary)
P. Tschirren, EM, Marin (Treasurer)
Dr. F. Bonzanigo, ETH, Zurich (Member)

I would like here to thank the past ExComm Members for the very pleasant cooperation and to wish the new ExComm a great success in the future.

During 1996 the Swiss Reliability Chapter organized, in cooperation with the Reliability Laboratory (RL) of the Swiss Federal Institute of Technology (ETH) Zurich, five meetings, two courses, and a one-day International Conference on Reliability Engineering 2000 (Oct. 17) with such well-known speakers as Professor Trivedi, Professor Littlewood, Dr.Bennetts, and Professor Schneeweiss, among others. Professor A. Birolini gave his course on Quality and Reliability of Equipment and Systems (Sept.18-20) whereas M. Ciappa and P. Malberti held their course on Failure Mechanisms and Failure Analysis twice (April 23-25

and May 21-23). The meetings were: Latent Gate Oxyde Damage due to Electrostatic Discharge of Integrated Circuits (Dr. J. Reiner, Philips Semiconductors, Zurich, Jan. 29); Choice and Application of Techniques for the Reliability Analysis of Auxilliary Units for Gas Turbines (Dr. H. Roennebeck, ABB Power Generation, Baden, April 29); A Finite Element Program for Reliability Prediction of Solder Joints (Dr. K. Heiduschke, ETH/RL, Zurich, June 24); Modelling Complex Systems Using Boolean Functions (Dr. B. Gerlach, Humboldt University, Berlin, Germany, Oct. 28); and Performance and Reliability Analysis of Fault-Tolerant Systems (Dr. A. Brenner, ETH/RL, Zurich, Nov. 11)

For 1997, five meetings, two courses, two workshops and one seminar are planned. The course by M. Ciappa and P. Malberti on Sample Preparation Techniques for Failure Analysis of Silicon and III/IV Devices has been already held on Febr. 19-20. On Jan. 20 Dr. R. Brinkmann, Georg Fischer, Schaffhausen, talked on the Modelling of Reliability Growth of Complex, Repairable Systems and on Feb. 24 Dr. R.G. (Ben) Bennetts, LogicVision Europe, Burridge UK, talked on Built-In Self TEst for Electronic Products: the New Wave of Design to Test.

One-day seminars
Oct. 14 - Applications of Focused-Ion Beam (FIB), ETH Room ETZ E6, 9:30 am-5:00 pm.

Workshops
Aug. 21 - Quality and Reliability of Fine-Pitch SMT Solder Joints, ETH Room ETF C1, 9:30 am - 5:00 pm.

Oct. 6 - Plastic-Packaged Devices for High-Reliability Applications, Bordeaux/Archachon, France, in conjunction with ESREF'97.

Courses
Sept. 17-19 - Quality and Reliability of Technical Systems, ETH Room ETZ E6, 9:30 am - 5:00 pm. (Professor A. Birolini)

Meetings
June 23 - Reliability and Life-Cycle Test Design of SMT Taking into Account the Mechanical Behaviour of Solder Materials (Dr. L. Weber, ETH/RL, Zurich)

Oct. 27 - Reliability of FLOTOX Cells for EEPROM Memories (Dr. M. Ciappa, ETH/RL, Zurich)

Nov. 17 - Safety and Reliability of Railways in the Course of Time (P. Jacob, ETH/RL, Zurich)

The meetings take place at 5:15 pm at the ETH Zurich, room ETF C1. For further information please call Ms. Sybill Steffen at +41 1 632-2743, fax: +41 1 632-1258, e-mail: sekr@zuv.ee.ethz.ch.

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COMMENTARY ON STATE OF RELIABILITY ENGINEERING DISCIPLINE

As head of the US TAG to TC 56, the IEC Dependability Technical Committee I would like to offer some comments on the insightful article on the "State of the Reliability Engineering Discipline" by A. Coppola in the April '96 issue of the IEEE Reliability Society Newsletter.

In his article Mr. Copolla mentions the problem of avoiding duplication of effort in developing new standards. Although the RMS Partnership is supposed to informally coordinate the standards writing of the different societies, there has long been an rational apparatus for doing this. Standards proposed to ANSI as National Standards undergo a review process to avoid duplication and conflict with existing national standards. The IEEE Reliability Standards writing groups seem to be well aware of this and are following the ANSI process, but I do not believe the other societies are.

I was pleased with Mr. Copolla remarks about the failure to make use of existing IEC Dependability Standards. I agree that a big reason is that much of the "Mil-Spec" community is simply ignorant of their existence and content. It is true that some of the Dependability documents are general and less prescriptive than the MIL-STD's, in part because they were developed for a broader spectrum of commercial usage. It is also true that they are collectively better integrated, use a consistent vocabulary, and are mathematically more precise than the Military Standards ever were. They are true international standards , available in multilingual form, and thus can be of great importance in international commerce.

I urge U.S reliability practitioners to consider taking a more active role in IEC Standards process. The IEC requires that all standards be reviewed at five year intervals when they can be renewed, revised or eliminated. If there is a compelling need for a new reliability standard then a new work item can be initiated to create a new IEC standard.

Members of the Reliability Society who may want to learn more about IEC Dependability Standards and possible participation in the US TAG to TC56 can contact me at any time.

As a final note be advised that a new Web site for the entire IEC (www.iec.ch) is now operational. The site will provide information on TC 56 organization, working group membership, and status of all published Dependability Standards and ongoing projects.

John A. Miller

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Chapter Activity Awards - 1996

The Chapters Award Committee has received program information from a record number of chapters this year: 12. The high level of local program activity is very encouraging. many chapters have six to 12 programs each year for the RS membership.

We are further encouraged by the response of these volunteers in submitting reports of their programs to the RS Newsletter. For the period, July 1, 1995 through June 30, 1996, there were 21 Chapter Reports in the Newsletters.

We are please to report the winning chapters which had the most active and significant local programs plus high level of activity of the local membership.

- 1st Place - Boston Chapter: $500
- 2nd Place - Switzerland Chapter: $300
- 3rd Place tie - Dallas Chapter: $200
- 3rd Place tie - Denver/Pikes Peak Chapter: $200
- Entered Baltimore Chapter: $100
- Entered Cleveland Chapter: $100
- Entered Los Angles Area Chapter: $100
- Entered Philadelphia Chapter: $100
- Entered Santa Clara Valley (CA) Chapter: $100
- Entered Singapore Chapter: $100
- Entered Tokyo Chapter: $100
- Entered Washington DC/Northern Virginia Chapter: $100

The Chapter Awards will be presented at the AdCom Meeting Banquet, Sunday evening, April 6, 1997. This AdCom meeting is being held in conjunction with the International Reliability Physics Symposium, Adams Mark Hotel, Denver, Colorado, April 7-10, 1997. We ask that the President or President Elect announce these Chapter Awards in their Report in the upcoming RS Newsletter.

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The Status of the Reliability Engineering Technology

January 1997
A report to the IEEE Reliability Society

Introduction: The reliability engineering discipline continues to change its approaches and its focus, in response to changes in technology and in philosophy. Many of the current trends fulfill predictions made in previous status reports, and by other sources including a paper by Kam Wong given in 1982. The quality revolution started in the 1980s seems to have worked, but there are still plenty of reliability problems to be solved. Examples of these general comments will appear in the following discussions.

General overview: Any one who recalls the dark days of the American automobile industry, when high quality imports captured the market, should agree that the quality revolution sparked by this situation seems to have worked. Cars, and other major products, American and foreign, are designed for, and frequently sold on, their quality and reliability. However, there are still many product-specific reliability problems and some general problems.

Product specific problems are illustrated by not-infrequent automobile recalls, and, as written in the March 6, 1996 edition of the Wall Street Journal, by reliability problems with the Boeing 777 that prompted United Airlines to complain to the aircraft manufacturer that mechanical malfunctions were running approximately double what we expected.

Current generic problems include the susceptibility of electronic systems to failures caused by Electromagnetic fields, which prompted FAA rules against using personal electronic devices on take-offs and landings of U.S. airliners. The problem is aggravated by electronic complexity (according to one source, a signal must go through four microcomputers to turn on a reading light in the 777), and by practical difficulties in effectively shielding large wiring systems. Electromagnetic Compatibility has long been a military concern; it may well become one of the leading commercial reliability concerns.

Continuing as a military concern is the effects of extending systems lives as replacement funds continue to dry up. Problems include the obsolescence of parts employed and the obsolescence of support hardware and software.

In software, the year 2000 problem is the big news. Many programs have been written using only two digits for recording years. In finding the length of a time period, with starting and ending dates between 1900 and 1999, there is no problem. When the end date is 2000 or higher, many programs will produce negative numbers (e.g., computing (20)10 - (19)90 would yield a result of -80 rather than +20, because only the last two digits in each year would be recognized by the computer). The ultimate total cost for correcting "year 2000" problems is estimated by various sources in the tens to hundreds of billions of dollars. One source predicted a cost in the tens of billions for an orderly correction program by the industry and in the hundreds of billions for a last-minute panic.

Other concerns, both military and commercial, are noted in the following discussions of specific topics of current interest.

PEMs: One example of reliability engineering responding to both technology trends and customer policies is the current use of plastic encapsulated microcircuits (PEMs). Once out of favor for military use, the overwhelming market dominance of PEMs over other packages, and the current U.S. Military preference for using commercial parts, are encouraging the use of PEMs, even for military systems. On the technical side, users of PEMs are employing Highly Accelerated Stress Testing (HAST) and Acoustic microscopy to screen out flawed devices. While the reliability of PEMs is constantly improving, the variability between suppliers remains a problem. Rome Laboratory tests of a CD 4011 NAND gate, a mature device, found devices from one manufacturer showing severe delamination, another manufacturer's part showing some delamination, and three other manufacturers showing no delamination. Delamination opens pathways for contaminants, particularly water, to reach the chip surface, cau sing failure. In a paper presented at EUROCON in 1982, Kam Wong predicted that flaw control, screening and manufacturing control would become more common in reliability engineering and traditional reliability analysis would become less important. The current procedures in selecting PEMs seem to fulfill this prophecy.

Software: The chronic crisis in software (Scientific American, 1994), continues. According to a report of the Data & Analysis Center for Software (DACS) dated September 1996, in the United states, 25% of software projects are canceled, software products are often released with 15% of defects remaining in the product, and many companies spend 30% to 44% of their resources on software rework. In the February 1996 issue of CrossTalk, the Journal of Defense Software Engineering, Robert Bliss quotes

similar statistics and asks, "What other business has such a miserable track record?"

The DACS report estimates the return on investment for "Fagan inspections," software reuse, software "cleanroom" approaches, and software process improvements. In all cases, the returns are quite attractive. Previous status reports predicted that the potential for profit would ultimately drive software production from an art form to an engineering discipline. The DACS report, which is entitled "A Business Case for Software Process Improvement." supports that prediction. The report can be downloaded from the DACS website at URL: http://www.dacs.com.

Progress has, however, been slow. The Software Engineering Institute (SEI) has been ranking software producers on a Capability Maturity Model of five steps. The first step is essentially the production of software as art. Step two designates a repeatable process. Step three, a defined process. Step four represents a managed process and step five, an optimizing process. The first data collected by SEI between 1987 and 1991 found about 80% of software producers in the first step. This figure has declined steadily, if not rapidly, and in 1996 approximately 67% of producers audited were rated still in step one. In the same time, the percent of software producers in step two rose from about 12% to about 20%, Those in step three rose from about 7% to about 12%. Steps four and five have remained in the noise, currently sharing about one and a fraction percent of users. The U. S. Air Force has expressed a goal (but not a requirement!) that its software suppliers be at least level three on the SEI scale. In 1991, less than eight percent of suppliers could have met this goal. In 1996, this figure had grown to about 13.5%. A definite improvement, but not yet impressive.

The Capability Maturity Model (CMM) has received wide recognition, and SEI now offers some spin-offs, including a people CMM for rating the capability of the programmers, a Software Acquisition CMM for rating the acquisition process, and a Systems Engineering CMM evaluating a company's overall systems engineering process. More details are available from the SEI web site, URL:http://www.sei.cmu.edu.

However, potential users of maturity models, or other model-based management tools, might do well to review the article, "Reflections on the Capability and Maturity Models of Engineering Processes", by Henry J. Kohoutek, in the May-June, 1996 issue of Quality and Reliability Engineering International, which provides some caveats worth noting.

Acquisition reform: Fallout continues from the U. S. DoD acquisition reform policies. A June 1994 memo by Secretary of Defense William J. Perry abolished the use of military specifications and standards in favor of performance specifications and commercial standards in DoD acquisitions. Exceptions have been made for special cases (e.g., fragmentation grenades), but in the product assurance area, the military specifications and standards are disappearing. On 1 October, 1996, MIL-Q-9858, Quality program Requirements, and MIL-I-45208A, Inspection System Requirements, were canceled without replacement. Contractors will have to propose their own methods for quality assurance, when appropriate. (It is likely that ISO 9000, to be discussed later, will become the de facto quality system standard.)

The DoD policy allows the use of military handbooks for guidance. The U. S. Army, in a memorandum dated 15 February, 1996, by Gilbert F. Decker, Assistant Secretary of the Army, prohibits army acquisition requirements from citing even guidance documents without a waiver. This includes non-military standards produced by professional societies and organizations. Contractors, however, are free to propose any document they feel effective in meeting specified performance. For this reason, the Army will be updating MIL-HDBK-189, Reliability Growth Management, even

though they will not be specifying it as a requirement. Other military handbooks are being updated to preserve knowledge of potential use. Rome Laboratory is revising MIL-HDBK-338, Electronic Reliability Design Handbook, and creating a maintainability handbook from useful data in MIL-STD-470, Maintainability Program for Systems and Equipments, and MIL-STD-471, Maintainability Demonstration. Both standards were redesignated as handbooks in 1995, and will be replaced by the new handbook.

Many professional organizations are attempting to produce commercial reliability and maintainability documents to replace the vanishing military standards. The IEEE Reliability Society is one. Others include the SAE, SOLE, ADPA. et al. These efforts are loosely coordinated by a RMS Partnership including preparing organizations and the DoD. Besides them, there are a number of International standards (under the title of dependability standards) produced by International Electroctechnical Commission Technical Committee IEC TC-56, some NATO documents, British documents, and Canadian documents, any of which can be proposed by a contractor as a response to product assurance performance requirements. For this reason, A Primer for U.S. and International Commercial and Military Reliability, Maintainability, Availability and Dependability Hardware Standards is in preparation by Rome Laboratory. It perhaps should be noted that many of these documents were derived from the same basic sources, most often the U.S. Military standards.

While the DoD hope has been that commercial standards will arise to replace the military standards, the professional organizations preparing commercial standards have not found it any easier than the government to reach consensus. No standards have as yet achieved the stature of the vanishing military documents. As a result, many suppliers perceive a void in guidance. One attempt to fill this void was the publication of the Reliability Analysis Center (RAC) Reliability Blueprints in 1996. These are a set of six documents, covering Defining Reliability Programs, Developing Reliability Goals/Requirements, Designing for Reliability, Assessing Reliability Progress, Measuring Product Reliability and Ensuring Reliable Performance. RAC feels the set will provide a useful common reference for reliability engineers while the military and commercial standards sort themselves out. Also in 1996, McGraw-Hill released an update of the Handbook of Reliability Engineering and Management, another general reference.

ISO-9000, et al: The set of international standards on quality management, known generically as ISO-9000, is firmly established as the way to go in quality management. There are now over 120,000 firms worldwide certified as compliant to ISO-9000 requirements, including 11,000 U.S. sites. The big-3 American automakers, Ford, Chrysler and General Motors, have jointly issued what is known as QS-9000, a set of requirements for their suppliers, which includes ISO-9001 in its entirety. In December, 1995, NASA issued a policy statement directing the use of quality systems compliant with ISO-9000. NASA did not require third-party certification of compliance, avoiding the main issue with the international standard.

ISO-9000 requires the use of independent auditors to certify compliance of a site to an appropriate standard in the ISO-9000 series. This has been a worry to some sites. It was once feared that registration by auditors certified by one country may not be accepted by foreign customers, leading to trade barriers. This has not happened due to a combination of international agreements on accepting other nation's certification of auditors, partnerships between national and foreign auditors, and an apparent good-will effort by the international community to avoid the problem. QS-9000 requirements also aim at third-party certification, but the sponsors have provided time-tables for accomplishment (varying among the automakers). DoD allows its contractors to propose

ISO-9000 standards for their quality management system, but does not require third-party certification.

In 1996, ISO 14001, the international standard on environmental management systems, and ISO 14004, on general environmental management systems guidelines, were officially adapted by 40 voting countries. The ISO-14000 series parallels the ISO-9000 series, including the requirement for third-party certification. There has been much interest in the development of ISO-14000 documents, with guides to compliance published before the standards became official. As of this writing, ISO-14000 is not a requirement for anyone. The U. S. Environmental Protection Agency, for example, has not endorsed the concept of ISO 14001 registration. However, ISO-14000 could become as pervasive as ISO-9000. Paul Scicchitano, writing in the November 1996 issue of Quality Digest, considers the best advice on ISO-14000 to be, "Implement the principles...but hold off on registration until there's a clear benefit to doing so." Scicchitano edits a monthly newsletter on ISO-14000. For subscription information, contact Irwin Professional Publishing at (703) 591-9008. In addition, ASQC offers a quarterly newsletter called Focus on 14000 to track progress in its development. For information, call ASQC at (800) 248-1946.

The Web: The world-wide-web has become the first place many users seek information, and there is a considerable reliability presence on the web. Much of the information in this report was obtained from web sites. However, some major players are still missing from the web, such as IEC TC-56, the developer of the international standards on dependability.

Pages of links to reliability websites are maintained by the University of Maryland (at URL: http://www.enre.umd.edu /rmws.htm) and by the Reliability Analysis Center (at URL: http://rac.iitri.org/cgi-rac/refcats/). A general search for reliability sites can well begin at either of these locations. (The Reliability Society is at URL: http://www.enre.umd.edu/i3e/rs_home.htm)

Emerging Technologies: The Defense Advanced Research Projects Agency (DARPA) initiated a 17 million dollar effort for developing the automated tools for the design of devices integrating electronic, microelectromechanical, electro-optical and micro-fluidic devices in microsystems. This combination of technologies in miniature self-contained systems is expected to have a significant impact on future DoD systems, and will undoubtedly find its way into commercial products soon after its introduction by the military. Rome laboratory has been selected as a DARPA agent for the effort.

Rome Laboratory also reports developing a hardware approach to fault tolerance employing dynamically reconfigurable gate arrays which can reconfigure themselves as needed for a desired level of fault tolerance.

The last status report mentioned information warfare (military term) or (generically) information integrity as an emerging concern. Recent news reports of the interception of cell phone signals by dishonest entrepreneurs to obtain authorization numbers for fraudulent use, and the countermeasures taken by cell phone companies to detect "outlaw" cell phone calls, confirm this prediction. In this information age, engineering to protect information integrity may be reasonably considered a growth industry. A recent addition to the Information analysis Centers (IACs) sponsored by the Defense Technical Information Center (DTIC) is the Information Assurance Technology Analysis Center (IATAC), dealing with information security. It is interesting to note that this IAC is not a physical entity, but a virtual organization drawing upon other DTIC IAC resources on an ad hoc basis.

Changing roles: Quoting contributor Ned Criscimagna: "Based on our surveys...of nearly 60 companies..., it would seem that the reliability engineer is becoming a dinosaur. More and more

companies are doing away with reliability offices....Reliability engineering positions are being allocated to design teams with design engineers often filling the positions." Other sources have made similar comments.

This trend is probably based on the laudable intent to integrate the various assurance technologies into the design teams, and a belief that design engineers with reliability training are more valuable than reliability engineers with some design knowledge. There has been some concern expressed about whether the end result will be a better consideration of reliability in design or the slow reorganizing of reliability out of systems engineering.

Past issues of this status report have also predicted the disappearance of the general reliability engineer, but presumed he would become a specialist integrating reliability analysis capabilities into computer aided design (CAD) programs. This prediction is still reasonable, though reliability tools generally remain islands of automation needing bridges to other design programs. There are many developers of automated reliability tools, but not much evidence that they are integrating with other toolmakers, including each other. One exception may be the DoD Integrated Computer-aided Software Engineering (I-CASE) program. Originally conceived as a software engineering environment for large ADA developments, the program now provides CASE tools obtained from many commercial sources to smaller and more diversified software programs.

Other predictions confirmed: In past years, this status report has predicted a need for an analog equivalent to the VHSIC High-order Design Language (VHDL) to permit the exchange of design information among manufacturers of analog microcircuits. The October 1996 issue of the IEEE Spectrum included an article: A Design Language for Analog Circuits, supporting this prediction, and by implication considering it a mainstream electronic concern. Previous status reports also stated a critical need for built-in-self-test (BIST) in complex microcircuits. An article, Testing Systems on a Chip, in the November 1996 Spectrum, notes the problems of testing complex microcircuits and the emergence of BIST as a preferred approach.

Consortiums: Perhaps because of declining funding, there seems to have been an increase in the use of consortiums in reliability research and development. Consortiums are being used by the Reliability Analysis Center to compile and disseminate data on parts and systems, by the University of Maryland in their reliability physics research and development programs, and by Rome Laboratory in software reliability studies. There are also some European consortiums for reliability. On the other hand, Project ARIES, a consortium originally formed by the sponsors of the annual Reliability and Maintainability Symposium to develop reliability CAD tools, is currently inactive.

Partisanship: One effect of changes in the discipline has been some polarization of opinion. There have been voices stridently proclaiming the value of a favored approach to achieving reliability, or, more often, decrying the value of opposing approaches. For example, the use of U. S. Military standards has been derided by some as not being the way modern businesses achieve high reliability (others have concluded that successful businesses have made much use of reliability engineering procedures adapted from the military standards). In contrast, Kam Wong's 1982 paper predicted many changes in emphasis, but did not show any approach to reliability displacing all others. This type of dispute has been seen before, in the quality discipline, when some followers of Deming, Juran, and Crosby derided each other while (in the opinion of one national news magazine, at least) their principles quietly adopted each other's good points into their own philosophies. Ultimately, it will not matter to reliability practitioners whose voice was the loudest; the approach most useful to a given problem will be the one used by competitive companies. Under

the current DoD acquisition policy, this will be as true for military procurements as it has been for commercial ventures.

Disclaimer: While the sources of the information used in this report are many, the synthesis is ultimately the result of one man's effort. Thus, this report is vulnerable to bias towards the subjective opinions of the undersigned. While any deviation from objectivity is purely unintentional, caveat emptor.

Anthony Coppola
Chairman
Advanced Technology Committee

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Annual Status Report Invites Your Input

The Annual report on the status of the reliability technology is compiled each year by the Advanced Technology Committee of the Reliability Society. The current report is presented in this issue. Your comments on the report would be welcomed for use in the preparation of the next annual report. Especially valued would be information on new developments or trends not covered in the latest report. Send any input to Anthony Coppola, IITRI, 201 Mill street, Rome NY 13440, fax to (315) 337-9932, or E-mail to acoppola@rome.iitri.com. Any contribution will be appreciated.

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Technical Committee Membership

The IEEE Reliability Society national organization is recruiting technical committee members and possibly committee chairpersons for the following technical committees:

- Standards and Definitions
- Software Reliability
- Advanced Reliability Techniques and R&D
- CAD, Concurrent Engineering, and Expert Systems
- Computers, Information Systems, & Telecommunications
- Emerging (New) Technologies
- Energy Systems Reliability & Energy Technology Assessments
- Health Care and Medical Reliability
- Human Performance Reliability
- International Reliability
- Maintainability
- Mechanical Reliability
- Nuclear Reliability
- Quality Assurance Technology
- Systems Screening and Testing
- Total Quality Management (TQM) & Process Reliability
- Vehicular Technology & Transportation Systems

The basic work for each technical committee consists of writing two short articles for the Society newsletter and writing an annual assessment of the technology in the committee's area of interest. Other work may include the development of standards, guidebooks and video tutorials. Working in one of the technical committees is an excellent opportunity to "network" and keep your knowledge current. If you are interested, please contact me and end a short biography with an indication of your experience in the field of interest.

If you do not have a direct interest in either of the above opportunities, please pass this to a fellow reliability, hardware, software, or systems engineering professional who might have an interest.

Thanks for your consideration.

Ken LaSala
VP Technical Operations
Tel: 301-713-3352
kenl@sao.noaa.gov
TWBT41B@prodigy.com

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IEC STANDARDS

The following international standards are being circulated for comment. Summaries are provided for your information.

IEC 56/555/NP - Risk Management

This newly proposed standard provides a generic framework for the identification, analysis, assessment, treatment, and monitoring of risk. It includes the elements of the risk management process but excludes specific references to a particular industry or economic sector. Risk management is recognized as an iterative process. More specifically the standard addresses the following aspects of risk management: process, policy, organization, management review, implementation program, establishing the context, risk identification, risk analysis, risk evaluation, risk treatment, monitoring and review, and documentation. There are seven annexes. The standard refers to IEC 300-3-9 (1995) on risk management.

IEC 300-3-5 - Dependability Management - Part 3: Application Guide - Section 5: Reliability test conditions and statistical test principles

This International Standard replaces IEC 605-1 and is an application guide for test conditions and statistical tools that are used to analyze data from reliability tests of repaired or non-repaired items. it is also a general guide to planning, performing and analyzing data from reliability tests. It refers to statistical tools for analyzing constant and non-constant failure intensity and instantaneous failure rate and other measures such as success/failure ratio. This standard does not cover software testing. Refer to IEC 1074 for that subject. However the standard is applicable to items that contain both hardware and software. The standard focues on sequential and fixed time/failure testing.

IEC 300-3-10. Dependability Management - Part 3: Application Guide - Section 10: Maintainability and Maintenance Support.

This document is an application guide for maintainability and maintenance support which can be used to implement a maintainability program that covers all phases of system development. The document advocates a tailored approach to a maintainability program. The document addresses criteria for the development of maintainability programs and the elements of the maintainability program. The scope and purpose are quite similar to the former MIL-STD-470. The document provides a substantial amount of information on what is to be done to support maintainability but little on how to perform the tasks. Specific topics are: planning and constraints, maintainability studies, project management, design for maintainability, externally provided products, analysis and prediction methods, verification, validation and test, life cycle cost program, operation and maintenance support planning, improvements and modifications, collection and analysis of maintainability data.

IEC 300-3-11 - Dependability Management - Part 3: Application Guide - Section 11: Reliability Centered Maintenance

This document is an extension of IEC 706-4: Guide on Maintainability of equipment: Maintenance and Maintenance support Planning. The methodology described in this standard is

based largely on the tried and tested procedures of Air Transport Association of America document MSG-3, "Airline/Manufacturer Maintenance Program Planning Document." The document explains RCM principles and demonstrates their use by the RCM methodology. The document describes maintenance program objectives, development of Reliability Centered Maintenance (RCM) based preventive maintenance programs, and maintenance program content. Also, it described functionally significant item failure analysis, maintenance task selection, and types of maintenance programs (initial, in-service, age exploration), and a zonal inspection program. There are three annexes that describe the maintenance development program for structures, definitions, and worksheets. This document is restricted to the application of RCM techniques and does not include aspects of maintenance support which are covered by other standards in the IEC 706 series.

IEC 605-6. Equipment Reliability testing - Part 6: Tests for the validity of the constant failure rate intensity assumptions.

This standard specifies the graphical and goodness-of-fit procedures to verify the assumption of a constant failure rate or constant failure intensity as defined in IEC 50(191). These procedures are applicable whenever it is necessary to verify these assumptions. Each test in this standard has one of the two following purposes:

1. to test whether the times to failure of items are exponentially distributed; i.e. the failure rate is constant;
2. to test whether the times between failures of a single repaired item do not have any time trend; i.e. the failure intensity does not exhibit an increasing or decreasing trend.

The graphical method consists of plotting on semi-log paper. The goodness-of-fit procedures include the standard chi-squared method and other methods.

EIA 632 - Processes for Engineering A System

This standard is intended to be the primary standard for engineering a system. Lower tier standards may be developed to assist users in applying this standard. The intended users of the standard include: system developers, standards developers, educators, developers and users of maturity and self-assessment models. The standard includes references, definitions, requirements, application guidance, and several annexes. The requirements address: the acquirer-supplier agreement process, the planning process, the system design process, the control process, and the system qualification process. Application guidance addresses the project context, the building block concept, and development layers. The annexes provide a glossary, desired characteristics of system requirements, the objectives of the processes described in this standard, planning documents, steps in defining system technical requirements, steps in defining a technical solution, and considerations for assessments and trade-off studies. With the annexes, the standard is 85 pages in length.

Ken LaSala

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Reliability Society Members Receive IEEE Fellow Recognition

The following 5 Reliability Society Members have been honored by IEEE by being elected to the Fellow Grade. These five individuals were so recognized by their extraordinary achievements in their technical field. Each was recognized as follows:

Professor Shigeichi Hirasawa (Tokyo, Japan) -- For contributions to the development of channel coding schemes and error-correcting codes.

Professor Yinghua Min (Beijing, China) -- For technical leadership in electronic tesing and fault-tolerant computing.

Professor Behrooz Parhami (Santa Barbara, CA) -- For contributions to the design of high-performance digital systems through arithmetic algorithms and highly parallel architectures.

Professor Cauligi S. Raghavendra (Pullman, WA) -- For contributions to design and analysis of interconnection networks and fault tolerant computing.

Mr. Yasua Watanabe (Yokosuki, Japan) -- For contributions to the development of insulation of UHV ac and dc transmission lines and analysis of lightning performance of overhead power transmission lines.

All of these people deserve the very best congratulations that we can offer. They have distinguished themselves among us and are a major benefit to the Reliability Society, IEEE, their companies or universities and to all of the World. I am sure that their past and present work will reflect this contribution for years to come.

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RAC Data Sharing Consortium (DSC)

IITRI's Reliability Analysis Center (RAC) has initiated a Data Sharing Consortium (DSC) which compiles and disseminates data on parts and systems. The consortium is open to all commercial, U.S. government, and foreign organizations. Various levels of participation exist. The RAC is a DoD sponsored Information Analysis Center (IAC) whose purpose is to collect, analyze, and disseminate data and information pertaining to the reliability and quality of components and systems. The purpose of the DSC is to accumulate data from various sources and assemble this data into a repository accessible to members of the DSC. There are currently many commercial organizations performing component testing to insure that the parts selected for their products are robust enough to operate reliably in the field. This testing can be very expensive and there is typically little or no sharing of data between organizations. Advantages of data sharing include cost savings from the reduction and/or elimination of redundant testing and the accumulation of a greater base of data with which to evaluate the quality and reliability of parts and systems. Types of data contained in the DSC include screening, qualification, failure analysis, and field performance of components and systems. The purpose of the DSC database is to track screening, qualification, test, and field data for components and systems. The results of failure analyses identifying the cause(s) of failure are provided when available. Obsolescence information is also provided to assist with life cycle management. The database is in the initial phases of development starting with screening and qualification of semiconductor devices. Data on other part and data types will be implemented in early 1997. The DSC database is a secure area and access is controlled by a login and password. Netscape version 2.0 or higher is required to access the DSC database. A guest account is available to view a fictitious sample of the data. To use the guest account, type "guest" for both the Username and Password. You can review the RAC Data Sharing Home Page at http://rac.iitri.org/consortium/

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Software Reliability Insights

I received the following comment regarding a draft software

reliability article:

"MTBF is a meaningless measure, particularly for critical software. The MTBF of the Ariane software might have been extremely high, but one bug made it disastrous! Other programs might have several minor bugs that do not cause serious problems. Just adding failures together as though they are apples or voltage drops is wrong and very misleading. At least for hardware we can add failures together if they all generate logistics needs (spares, repairs, warranty costs, etc.), but for software it makes no sense and is of no value." I would like to hear your opinions.

Software reliability differs from hardware reliability. Nothing breaks in the software when it fails--except -- the underlying logical process. That is, the software script (logic or instruction set) does not properly handle the condition presented to it. Software prescribes certain actions based upon specified events occurring. Software is a script and it makes a lot of assumptions. Some of these assumptions are stated and some are made unknowingly or unsuspectingly. To the degree that the software script departs from the user's needs, it will be considered a failure by the customer (user). The customer is the final judge. Often the software operates as designed but does not meet the customer's needs. This disconnect is classified as "requirements deficiencies". It is the number one contributor to software failures.

The customer is defined as the end-user of the system. In a client-server system, customer is sometimes called the "seat" or the client. A failure at the server end of the system would potentially be counted by all clients. On a work station, the user is the operator of the work station. In an airborne application, the pilot or navigator is the user of the navigation and communication software. A failure is counted for every time the software departs from the users specified performance. This is from a technical stand point. The user will actually count failures for every time the software departs from its user's expected performance.

Consider the following simple equation:

A + B = C. (1)

If A and B are Boolean operators, then C will equal 1 if either A or B are 1 and will be 0 otherwise. That is the intended operation. But instead of a 0 or 1 input what happens if a negative number is presented, or an alpha character, or a number different from 1 or 0? The programmer might think that cannot be allowed to happen, but sometimes it does happen. So real programs typically contain 30% of the code to handle its intended purpose and the other 70% to handle possible exception conditions such as the one just described. I heard the noted Dr. Harlan Mills talk about his software reliability experiences. One time IBM called him in to solve a serious JES problem. He redrew the program logic using his structured programming techniques. He found the main line code to be flawless. He found plenty of improvements to make in the exception handling code, which is 70% of the code. The exception handling code is too often an after thought, added after the operating code is built.

In software we talk about FAULTS. These are the causes of failure susceptibility. In the equation above the fault might be vulnerability to out of range data. The defense would be to check the range of the input data. FAILURES are the departure of program operation from the user's desired (specified) operation. The biggest driver of field maintenance in software comes from deficiencies in the defined requirements. Very often software problems reveal requirements that were not previously recognized, stated or understood.

The frequency of software failures typically outnumber hardware failures by an order of magnitude (Koss, RAMS Proc 1988; personal experience analyzing outages on AF ground control station). However they usually can be recovered very quickly, in

comparison to hardware failures. This is true for a system designed under a rigorous process and built for high availability.

100 little bugs in the code

fix one bug, compile it again

101 little bugs in the code

Repeat until bugs = 0

Samuel Keene
skeene@hacemx.hac.com

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The R&M CAE in CE Workshop at RAMS
Help Plan the 1998 Workshop

The R&M CAE in CE Workshop tract at the 1997 RAMS was very successful. Copies of our 2 volume "Workshop Proceedings" (papers and presentation material given in the Workshop) plus copies of the "First Principles of Concurrent Engineering" were distributed to the Workshop attendees. All of the Speakers did an excellent job of presenting the latest information on Concurrent Engineering / Integrated Product Development, on the newest releases of R&M CAE applications, as well as on advanced R&M CAE capabilities being developed within research centers.

If you would like to get involved with the planning of the 1998 Workshop, please contact Dennis Hoffman at 972-997-2270 or at dhoffman@ti.com. We would enjoy having your participation.

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RELIABILITY SOCIETY MEMBERSHIP

The IEEE Membership Development Committee (MDC) has been working to find ways to increase the IEEE membership in general. A recent report from MDC states their goals for 1997.

They have developed plans for effective membership development in six areas:

1. Emphasize the value/benefits of IEEE membership.
2. Involve all IEEE entities and staff in coordinated membership activities.
3. Encourage and motivate volunteerism, participation and recognition.
4. Fully understand and measure member needs and feedback.
5. Create innovative programs for member retention, especially for recent graduates (students).
6. Work cooperatively with Technical Societies to seek out and recruit members from non-traditional sources.

Per goal #5 , they have some specific programs that they are recommending to the Sections, Chapters and Societies. Two of these plans are of interest to me so that I would like to present them to our Reliability Society members.

The first program is called the GOLD program; It's goal is to convey the tangible and intangible benefits of IEEE membership to the new Graduates. Along with this, some ideas as incentives have been proposed to induce the new Graduates (with or without a job) to stay in the IEEE. The best one is to provide a sliding membership fee over the first three years out of school. Basically, the membership fee would be much less the first year, and increase through the next two years to the full cost on the fourth year after graduation. This would seem to be fair, since new Graduates, even if they find good employment, have a lot of expenses which usually exceed their income for the first three or

more years.

The second program is called "Member-get-a-Member". I like this idea. It is really how most of the Reliability Society members that I know got involved. It's a peer thing. I really think that a lot of IEEE members joined the IEEE to be able to communicate (talk) about their specific and different involvement as an Electrical Engineer in some special field. At least that seems to be true in Reliability. There were not too many Reliability Engineers in Colorado back in the early 1980's. And it was well worth joining IEEE to belong to a Reliability Chapter of IEEE just to be able to talk about something I was very interested in with other Reliability Engineers that had similar interests and problems. We shared our ideas, knowledge and sources of information at the meetings and on the phone. This was quite different from a lot of my coworkers (not interested in Reliability) who considered Reliability as black magic or statistical non-sense.

Here is the reason I wrote this article. I think that the IEEE Reliability Society has an unique situation and opportunity to apply both of these programs to get more members.

1. The Reliability Students are few and special and should want the same peer relationships as they step from school into industry (careers). The lower membership fees should be the additional incentive to get them to stay. However, we (the existing Reliability Society members can also help them by getting them much more involved in our meetings and conferences now. If they can be involved and see how we can gain from each others experiences and knowledge, they will want to continue in the Society and IEEE.
2. The Member-get-a-member program seems to be a good fit for our society. Most of us are in a minority within the companies that we serve. We need to have honest objective feedback on our reliability technology and techniques from our peers in Reliability. This should make it easy to get other Reliability Engineers in the geographical area to join us.

If we make the effort and if the IEEE Org. would give us a financial reward for that effort, we should be able to increase our membership significantly. The type of incentive that I suggested to the MDC was that each IEEE member that recruited a new member should have 10% reduction of their membership dues next year. Get ten new members, and you don't have to pay any fees next year.

I would appreciate you feedback on this idea and any other ideas you might have on getting more members into the Reliability Society of IEEE.

Please respond to me via E-mail (j.r.adams@ieee.org) or by FAX (303) 530-6313 (ADAMS).

John R. Adams
Membership Vice President of the IEEE Reliability Society

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Request for AdCom Nominations

It is time to consider nominations for the Reliability Society Administrative Committee Members who will serve the Society from 1998 through 2000. There are two ways for a candidate to be placed on the ballot:

- 1. A nominating petition signed by ten or more Reliability Society Members in good standing (excluding student members),
- 2. Selection by the Reliability Society's Nominating Committee.

Last year seven candidates were placed on the ballot, which does not distinguish between type 1 and type 2 candidates. None were nominated by petition and all candidates were placed on the ballot by the nominating committee.

The sponsor of a nominee should secure the candidate's willingness to serve (The AdCom meets four times per year. Expenses for attending the meetings are not borne by the Reliability Society).

A Nominating Petition signed by at least ten members of the Reliability Society (excluding student members) and a biographical sketch should be included in the submittal.

For uniformity, the biographical sketch should be typed (Courier 12) and include four sections:

- 3. Education: Degrees, Universities, Subjects
- 4. Work Experience
- 5. IEEE Experience
- 6. Other

The biographical sketch should be limited to one side of one 8.5" x 11" sheet of paper. The nominating material: 1) Agreement to serve if elected (signed), 2) Biographical sketch, and 3) Nominating petition, should be sent before June 1, 1997 to:

Richard Doyle
Doyle And Associates
5677 Soledad Rd.
La Jolla, CA 92037
E-mail: r.doyle@ieee.org (with signatures mailed separately)

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Component Technology Conference

Component Technology Conference Summary

February 3-5 IEEE cosponsored the "Electronic Components For The Commercialization of Military and Space Systems Workshop" in San Diego. Attendance was a virtual who's who amongst people and companies in the satellite industry. A very lively PEM (Plastic Encapsulated Microcircuit) versus Ceramic debate occurred on Monday and Tuesday. The OEMs and government research labs presented reliability studies that demonstrated the use of PEMs are viable for some applications. Digital PEMs from "best-in-class" manufacturers are more likely to be acceptable than linear PEMs. Reliability engineers should review the following published documents:

- "Commercial Parts and Processes for Military Applications" (RAC)
- "Semiconductor Packaging, a DoD Dual Use Technology Assessment" (Rome Labs)
- "Overcoming Barriers to the Use of Commercial Integrated Circuits Technology in Defense Systems" (Rome Labs)

A second conference theme involved COTS (commercial off the shelf) components and the efforts to discontinue non-value added government/NASA requirements. A new ANSI document "Parts Management Recommended Practices" (AIAA-R-100) will define the "best practice" philosophy now being adopted in government contracts. Wednesday concluded with several good presentations on radiation sensitivity. Leon Hamiter did an excellent job organizing this workshop.

Jim Weiler, TRW (Chairman, LAC CP&MT-S Chapter)

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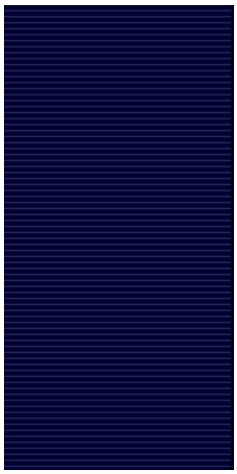

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